

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) EP 1 072 691 A3

(12)

EUROPEAN PATENT APPLICATION

(88) Date of publication A3:
23.01.2002 Bulletin 2002/04

(51) Int Cl.7: C22C 38/22, C22C 38/24

(43) Date of publication A2:
31.01.2001 Bulletin 2001/05

(21) Application number: 99123519.3

(22) Date of filing: 25.11.1999

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: 30.07.1999 JP 21622799

(71) Applicant: HITACHI METALS, LTD.
Minato-ku, Tokyo (JP)

(72) Inventors:
• Kubota, Kunichika
Yasugi-shi (JP)

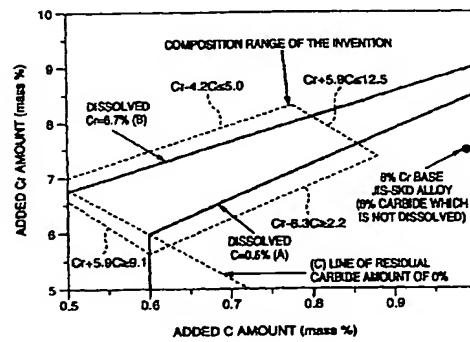
- Yamaoka, Miki
Ichikawa-shi (JP)
- Abe, Yukio
Yasugi-shi, Shimane-ken (JP)
- Tamura, Yasushi
Yasugi-shi (JP)
- Kada, Yoshihiro
Yasugi-shi (JP)

(74) Representative: Strehl Schübel-Hopf & Partner
Maximilianstrasse 54
80538 München (DE)

(54) **Tool steel with excellent workability, machinability and heat treatment characteristics, and die using same**

(57) Provided is a tool steel which contains, by weight, C and Cr in both of which $(Cr + 5.9 \times C)$ is 9.1 to 12.5, $(Cr - 4.2 \times C)$ being not more than 5 and $(Cr - 6.3 \times C)$ being not less than 2.2. In addition to these elements, this tool steel preferably contains 0.1 to 0.6% Si, 0.1 to 1.2% Mn, at least one of Mo and W of 0.6 to 1.25% in total in terms of $(Mo + 1/2W)$, less than 0.5% V, not more than 0.12% S, not more than 100 ppm of Ca, and the balance Fe and incidental impurities. Moreover, in this tool steel, the Cr segregation range in matrix after hardening is not more than 1% by weight, or the maximum tempering hardness by tempering at a temperature of not lower than 500°C is not less than 57 HRC, or a size variation due to heat treatment occurring by tempering at a temperature of not lower than 500°C is not more than 0.1% relative to the size measured just before hardening in terms of linear expansion coefficient and a size variation due to heat treatment by tempering at 490°C is not more than 0. Provided is also a die made by tempering the steel of the invention to a hardness of not less than 55 HRC and cutting the steel.

FIG.2



EP 1 072 691 A3



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number

EP 99 12 3519

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int.Cl.)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.)
X	PATENT ABSTRACTS OF JAPAN vol. 017, no. 232 (C-1056), 12 May 1993 (1993-05-12) -& JP 04 362153 A (DAIDO STEEL CO LTD), 15 December 1992 (1992-12-15) * abstract * * page 5; example 32; table 1 * * page 6; table 2 *	1-16	C22C38/22 C22C38/24
Y	EP 0 930 374 A (SANYO SPECIAL STEEL CO LTD) 21 July 1999 (1999-07-21) * page 3, line 6 - line 22; claims *	17	
A	—	1-16	
X	PATENT ABSTRACTS OF JAPAN vol. 1995, no. 07, 31 August 1995 (1995-08-31) -& JP 07 102346 A (DAIDO STEEL CO LTD), 18 April 1995 (1995-04-18) * abstract * * page 5; example 32; table 2 * * page 7; table 4 *	1,3-16	TECHNICAL FIELDS SEARCHED (Int.Cl.)
A	PATENT ABSTRACTS OF JAPAN vol. 1997, no. 02, 28 February 1997 (1997-02-28) -& JP 08 277444 A (SUMITOMO METAL IND LTD), 22 October 1996 (1996-10-22) * abstract *	1-16	C22C
A	PATENT ABSTRACTS OF JAPAN vol. 016, no. 474 (M-1319), 2 October 1992 (1992-10-02) -& JP 04 172113 A (SUMITOMO METAL IND LTD), 19 June 1992 (1992-06-19) * abstract *	1-16	
The present search report has been drawn up for all claims			
Place of search	Date of completion of the search	Examiner	
MUNICH	28 November 2001	Patton, G	
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone		T : theory or principle underlying the invention	
Y : particularly relevant if combined with another document of the same category		E : earlier patent document, but published an, or after the filing date	
A : technological background		D : document cited in the application	
C : non-written disclosure		I : document cited for other reasons	
P : intermediate document		& : member of the same patent family, corresponding document	

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 99 12 3519

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on. The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

28-11-2001

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
JP 04362153	A	15-12-1992	NONE		
EP 0930374	A	21-07-1999	JP	11193447 A	21-07-1999
			JP	11222624 A	17-08-1999
			AT	206485 T	15-10-2001
			DE	69801890 D1	08-11-2001
			EP	0930374 A1	21-07-1999
			US	6053991 A	25-04-2000
JP 07102346	A	18-04-1995	NONE		
JP 08277444	A	22-10-1996	NONE		
JP 04172113	A	19-06-1992	JP	8009045 B	31-01-1996